

TABLE 2.—Results of the long-range advance computation of precipitation amounts

Period	Rainfall amounts (mm.)		
	Normal	Forecast	Actual
March, 1921–June, 1921.....	156	<169	144
July, 1921–February, 1922.....	413	>364	378
March, 1922–December, 1922.....	499	>440	543
January, 1923–February, 1923.....	70	<82	78
March, 1923–October, 1923.....	398	<487	528
November, 1923–February, 1924.....	171	>134	219
March, 1924–May, 1924.....	111	>87	188
June, 1924–February, 1925.....	458	<660	465
March, 1925–June, 1925.....	156	<237	139
July, 1925–February, 1926.....	413	>416	501
March, 1926–May, 1926.....	111	>112	123

TABLE 3.—Example of the results of long-range advance computation of precipitation for individual months

Month	Rainfall amounts (mm.)	
	Forecast	Actual
1925		
March.....	<58	11
April.....	<64	50
May.....	<66	45
June.....	<49	27
July.....	<59	171
August.....	<73	11
September.....	<35	70
October.....	<40	85
November.....	<23	38
December.....	<38	47
1926		
January.....	<48	27
February.....	<43	52

In this case, also, the epoch falls in summer, and for it the forecast proves untrustworthy. The high July value is somewhat misleading, too, since the heavy precipitation is made up of heavy local showers. As for the period sums, Table 2 shows a good agreement, because for March–June a precipitation below 237 mm. was forecast and the actual was 139 mm.; for July, 1925, to February, 1926, the forecast gave more than 416 mm., the actual being 501 mm.

The purpose of these forecasts is not so much to give an advance computation of the precipitation for a particular month as it is to furnish an advance estimate of our lake levels for practical use in navigation and for the regulation of the lake levels. It is precisely for this purpose that the precipitation which has occurred during a long period over a larger area is quite as significant as the exact forecasting of water levels. . . . The generalized precipitation forecasts since 1915 compared with the amounts of precipitation observed in Svealand, and compared also with the corresponding previous year's rainfalls as well as with the normal values, . . . [together with] the generalized forecasts of water levels and the levels observed in Lake Siljan in Salarna<sup>2</sup> . . . show that the rainfall tendencies forecast for Svealand were verified in 13 to 14 cases out of a total of 15, and tendencies of water levels in 15 cases out of 16. Such percentages of hits may well convince one who does not demand too much of the method that it has a practical value.

<sup>2</sup> The author presents two tables embodying all these forecasts and their verifications.—B. M. V.

## BLUE-SKY MEASUREMENTS

By IRVING F. HAND

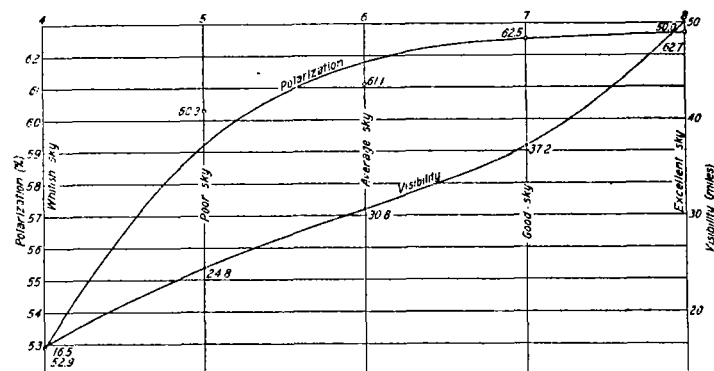
[Weather Bureau, Washington, June 30, 1927]

During the latter part of 1925 Dr. F. Linke, of the Universitäts-Institut für Meteorologie und Geophysik, Frankfurt on the Main, Germany, sent a series of color-match cards to 17 first-class meteorological services, one being the United States Weather Bureau. Commencing with January, 1926, the blueness of the sky has been noted at the Solar Observatory, American University, District of Columbia, on days when both solar radiation and skylight polarization measurements have been made. Linke states in his letter that the first measurements of the blueness of the sky of which we have record were made by H. B. de Saussure in Europe 150 years ago, and just a hundred years later the work was taken up by H. Wild. Although measurements of this kind have been made more or less frequently in Europe since the resumption of this research by Wild, but few have been made in this country.

The color-match charts consist of a series of 14 cards of graded hues ranging from almost white to a very dark blue, care having been taken to insure permanency of color and trueness of shade. The observation consists in selecting a card which when held against the blue sky 90° from the sun and in its vertical will most nearly match the color of the sky, which at this point is, generally speaking, the darkest. It is also the point of maximum polarization of skylight.

At Washington all the observations made to date cover the range of only the five cards numbered 4 to 8, inclusive. Skies whiter than that represented by card No. 4 are unfit for solar radiation measurements at

normal incidence, while skies darker than No. 8 have not been observed at this station. We may therefore, for the sake of convenience, arbitrarily designate the cards as follows: No. 4, whitish sky; No. 5, poor sky; No. 6, average sky; No. 7, good sky; and No. 8, excellent sky.



As will be seen from the figure there appears to be a very close relation between the blueness of the sky and horizontal visibility. This is to be expected as water vapor and dust both whiten the sky and decrease visibility.

The relation between sky color and the elements, visibility, polarization, solar radiation intensity at 2 air mass (zenith distance of the sun 60°), dust particles per cubic centimeter, relative humidity, vapor pressure, and

the average number of days since rain occurred is presented in Table 1.

Very slight correlation exists between sky color and the number of dust particles per cubic centimeter. This is probably explained by the fact that at Washington the dust particles consist principally of smoke of local origin, which does not extend to any considerable height.

The intensity of solar radiation increases with increase of depth of color of the sky, but the most rapid increase occurs with change in sky color from white to poor sky, and a small increase with change from poor to average sky. The increase from this point on is quite regular. It is thought that a longer series of measurements, which would tend to eliminate seasonal effects, would smooth out this apparent anomaly.

Generally speaking, there seems to be a fairly close relation between sky color and both relative humidity and vapor pressure. Unquestionably a longer series of measurements would intensify this relation. Unfortunately, however, the paucity of observations does not permit of dividing them into seasonal groups.

One of the most interesting facts brought to light by the table is the very close relation between sky color and the number of days since rain occurred. The reason is

apparent however, when we consider the efficiency of precipitation as a cleanser of the atmosphere.<sup>1</sup>

Rapid indications of the vertical distribution of precipitable water and dust in the atmosphere might be made by matching the color of the sky against these cards during airplane flights. Unquestionably, at an altitude of 15,000 feet skies as dark, as that represented by card No. 12 would be observed, and probably even darker.

TABLE 1.—Relation between sky-color and other meteorological elements

Color scale	Visi- bility	Skylight polari- zation	Solar radiation at normal incidence. 2 air mass. Gr. cal. cm. <sup>2</sup>	Number of dust particles per cubic centi- meter	R. H.	V. P.	Average number days since rain
	Miles	Per cent			Per cent	Inch	
4.....	16.5	52.9	1.02	883	52	0.228	2.5
5.....	24.8	60.3	1.18	594	53	.202	2.0
6.....	30.8	61.1	1.19	660	49	.126	1.8
7.....	37.2	62.5	1.26	528	44	.172	1.1
8.....	50.0	62.7	1.37	627	33	.031	0.0

<sup>1</sup> Kimball, Herbert H. & Hand, Irving F. 1924. Investigation of the dust content of the atmosphere. Mo. Wea. Rev. 52:133-141. Washington.

#### NEW DEFINITIVE SCALE FOR SOLAR-CONSTANT VALUES

The following letter explains a recent change made in the scale of solar-constant values published on the Washington Daily Weather Map:

SMITHSONIAN INSTITUTION,  
Washington, D. C., June 27, 1927.

DEAR PROFESSOR MARVIN: A few days ago we mailed to the observers in Chile an entirely new set of tables of reduction of the short-method and long-method observations which are based on an exhaustive study of four years of the latest and best observations.

As the values hereafter are intended to be definitive, I have directed the inclusion of a horizontal factor to be applied to all values to reduce them to the scale of 1920, which is also, so far as we know, the scale of the Mount Wilson observations. You will recall that in my recent paper entitled "A Group of Solar Changes"<sup>1</sup> I indicated in Table 2 that the values as now being furnished appear to be 0.012 calorie below the scale of 1920. The new definitive reduction which is entirely independent of this estimate and is based upon different data, indicates for that differ-

ence approximately 0.014 calorie; that is to say, the difference between the earlier estimate and this final reduction is within one-tenth of 1 per cent of the value of the solar constant.

We have compared a large number of results based upon the new method of reduction with the results which have been daily furnished you for the last 16 months, and we find that the average accidental difference of daily values (the definitive new method as compared with the provisional method) comes out 0.004 calories, or two-tenths of 1 per cent.

You will be glad to know that the definitive reduction has been based on Montezuma data alone, just as if no other station in the world existed, and that the residual corrections for imperfections of the function-transmission curves and for uncertainty of allowances for atmospheric humidity—those final residual corrections, I say—are always less than 1 per cent and for about 75 per cent of the days are less than one-tenth of 1 per cent. If they were omitted altogether, the result would be negligible in monthly means.

When the telegrams begin to arrive on the new definitive scale, there will be a sudden jump of approximately 0.014 calorie on account of the reduction to the scale of 1920. Thereafter I anticipate there will be no further change.

Very truly yours,

C. G. ABBOT, *Acting Secretary.*

<sup>1</sup> Smithsonian Misc. Coll., vol. 80, No. 2.